

C383 Exam 2 Version 1  
Fall 2016

Name White Key Seat Number \_\_\_\_\_

Student ID \_\_\_\_\_ Circle your section: **M T W R**

**The last page of this exam contains equations, constants, and area for scratchwork.**

The exam consists of 34 questions worth 100 points plus 5 bonus points on a total of 12 pages. It will be scored out of 100 points, with the maximum score being 100.

1-15 \_\_\_\_\_/30 multiple choice

16-30 \_\_\_\_\_/30 fill in the blank

31 \_\_\_\_\_/10

32 \_\_\_\_\_/10

33. \_\_\_\_\_/10

34. \_\_\_\_\_/10

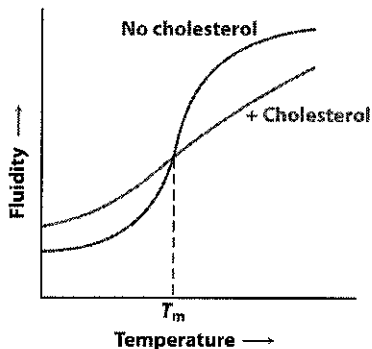
Bonus \_\_\_\_\_/5

Total:

**Regrading:** All requests for regrades must be submitted in writing within 48 hours of the return of the exam. You must explicitly state what has been misgraded and why it is an error. The entire exam will be regraded, which could result in points being added or deducted overall.

**Section 1: Multiple Choice. 15 questions, 2 points each.**

1. D Which of these statements is supported by data in this graph?



Problem 13.24  
Kochanska, E. & S. J. Drenth  
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- A) Increased concentrations of cholesterol lead to greater membrane fluidity.
- B) The melting temperature of a membrane is changed by cholesterol.
- C) Cholesterol disrupts tail-packing of phospholipids at high temperatures.
- D) Cholesterol makes membrane fluidity less sensitive to temperature change.
- E) More than one of the above.

2. D Which of these statements best describes  $k_{cat}$ .

- A) It is equal to the maximum velocity of an enzyme catalyzed reaction.
- B) It is a measure of enzyme efficiency at low concentrations of substrate.
- C) It is a measure of the affinity of an enzyme for its substrate.
- D) A higher value suggests that an enzyme is faster at catalyzing the reaction of substrate to product.

3. B The pH optimum curve for a typical enzyme is

- A) hyperbolic
- B) bell-shaped
- C) linear
- D) exponential
- E) directly proportional

4. C This type of inhibitor lowers both  $K_m$  and  $k_{cat}$  of a reaction:

- |                            |                             |
|----------------------------|-----------------------------|
| A) Transition state analog | D) Group specific reagent   |
| B) Competitive inhibitor   | E) Noncompetitive inhibitor |
| C) Uncompetitive inhibitor |                             |

5. A The strong affinity of the phenylalanine sidechain for the specificity pocket of chymotrypsin (shown below) results in

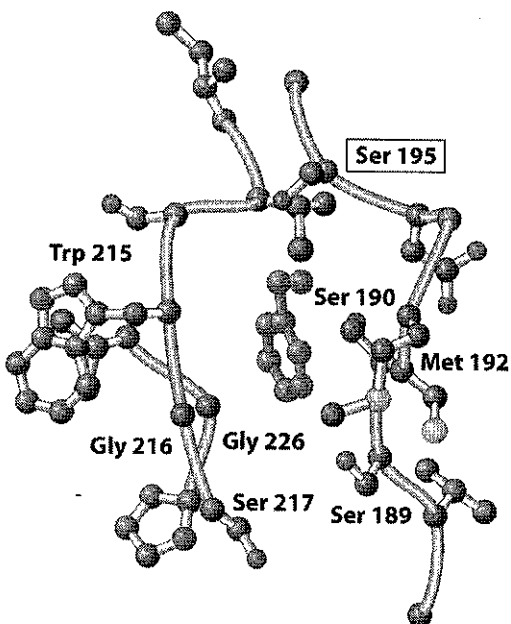


Figure 8.27  
Biochemistry: A Short Course, Third Edition  
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- A) a high value of  $k_{cat}/K_M$  of chymotrypsin for peptide substrates with phenylalanine.
- B) a low value of  $k_{cat}/K_M$  of chymotrypsin for peptide substrates with phenylalanine.
- C) a small turnover number for chymotrypsin.
- D) a large  $K_M$  of chymotrypsin.
- E) None of the above

6. E Oxygen bonding in one subunit of hemoglobin causes

- A) more salt bridges to form in the central cavity.
- B) tighter binding of 2,3-bPG.
- C) a shift of hemoglobin subunits from the R to the T state.
- D) all of the above
- E) none of the above.

7. D The affinity of hemoglobin for oxygen is decreased by

- A) 2,3-bPG
- B) lower pH
- C) carbon dioxide
- D) all of the above
- E) none of the above

8. B D- $\alpha$ -galactopyranose and D- $\beta$ -mannopyranose are related as
- A) anomers.
  - B) epimers.
  - C) enantiomers.
  - D) ketoses.
  - E) ~~more than one~~ of the above.  
none
9. C Some enzymes recognize starch but not cellulose because these polysaccharides differ in
- A) Carbohydrate composition.
  - B) Degree of branching.
  - C) Stereochemistry of the glycosidic bond.
  - D) Length of polymer.
  - E) Degree of hydrophobicity.
10. B Glycolipids such as cerebrosides and gangliosides
- A) Contain carbohydrates attached to amino acid residues.
  - B) Play key roles in cell-cell interactions.
  - C) Are based on a steroidal backbone.
  - D) Are asymmetric in the membrane, with the carbohydrate facing the cell interior.
  - E) None of the above.
11. B Passive transport is also called
- A) Active transport.
  - B) Facilitated diffusion.
  - C) Simple diffusion.
  - D) Secondary transport.
  - E) Pump transport.
12. A A 7-transmembrane helix protein associated with the membrane is likely an example of
- A) An integral protein.
  - B) A peripheral protein.
  - C) A reversibly anchored protein.
  - D) An irreversibly anchored protein.
  - E) A globular protein.

13. E Which of the following statements is true concerning all the signal transduction pathways we have studied?

- A) All have 7-TM receptors.
- B) All involve G-proteins.
- C) All involve dimerization of receptors upon ligand binding.
- D) All involve GTP as a second messenger.
- E) All utilize kinase activity.

14. C The majority of polysaccharide hydrolysis is performed in the

- A) Mouth.
- B) Stomach.
- C) Intestine.
- D) Pancreas.
- E) Gall bladder.

15. A Which of the following is not involved in lipid digestion, transport, and storage?

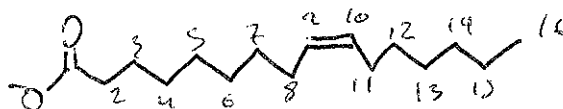
- A) Amylase
- B) lipase
- C) Bile salts
- D) chylomicrons
- E) All of the above are involved in lipid digestion, transport, and storage.

**Section 2: Fill in the blank. 15 questions 2 points each**

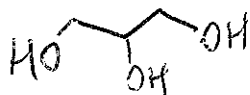
16. Michaelis and Menton showed that the initial velocity of an enzyme catalyzed reaction grows hyperbolically with respect to Substrate.
17. A "perfect enzyme" is said to be under diffusion control because it catalyzes reactions as fast as the enzyme encounters substrate.
18. For an allosteric enzyme, the shape of its velocity vs. substrate concentration graph is Sigmoidal.
19. When oxygen is bound to the heme group of hemoglobin, it is prevented from oxidizing the iron by the distal histidine residue.
20. Penicillin and aspirin are both irreversible inhibitors because they do not dissociate from the enzyme to allow it to become active again.

21. An E6V mutation in hemoglobin leads to the disease Sickle cell anemia.

22. Draw a (16:1) cis- $\Delta^9$  fatty acid.

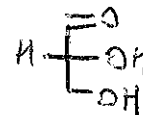


23. Draw glycerol:



24. Membrane formation is a consequence of the amphipathic nature of phospholipids and glycolipids

25. Draw the straight chain form of D-glyceraldehyde in a Fischer projection.



26. A transporter protein that opens in response to a change in membrane potential. Voltage gated.

27. The sodium/potassium ATPase is an example of a P-type ATPase that transports sodium out (in/out) of the cell against (with/against) its gradient.

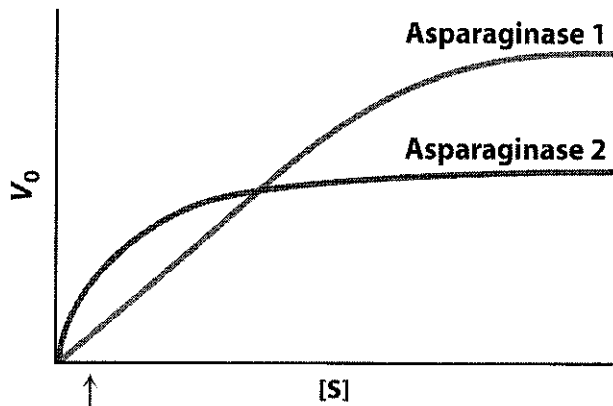
28. Symporter are transporters that use the flow of one species to drive the flow of a different species in the same same direction across the membrane.

29. cAMP (IP<sub>3</sub>, DAG) is an example of a second messenger.

30. Zymogens are inactive forms of digestive enzymes.

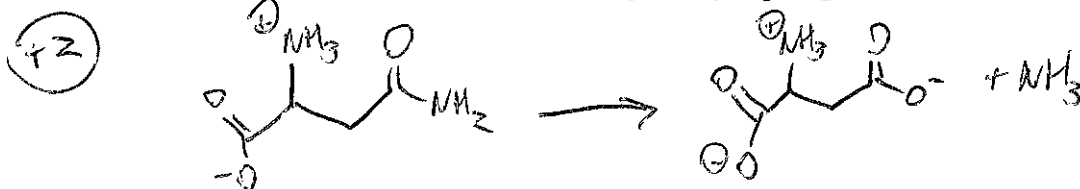
**Section 3. Problems. 4 questions 10 points each.**

31. Answer the following questions for the two isozymes of the enzyme asparaginase. The arrow below the graph indicates the typical physiological concentration of asparagine.



Problem 7.21  
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A. Draw the product(s) of the reaction catalyzed by asparaginase:



B. Assuming that the two experiments were done with the same enzyme concentration, which isozyme has a larger turnover number? Explain.

Asparaginase 1.  $k_{\text{cat}}$  is proportional to  $V_{\text{max}}$  and can be compared at the same  $[E]$ . #1 reaches a higher maximum velocity.

C. Which enzyme is more effective under physiological conditions? Explain.

At the indicated physiological  $[S]$ , the rate of rxn is faster for Asparaginase 2. Even though its  $V_{\text{max}}$  is lower, its  $K_m$  is much lower, making it have a higher rate at physiological  $[S]$ .

32. Answer the questions below based on the proposed mechanism of chymotrypsin.

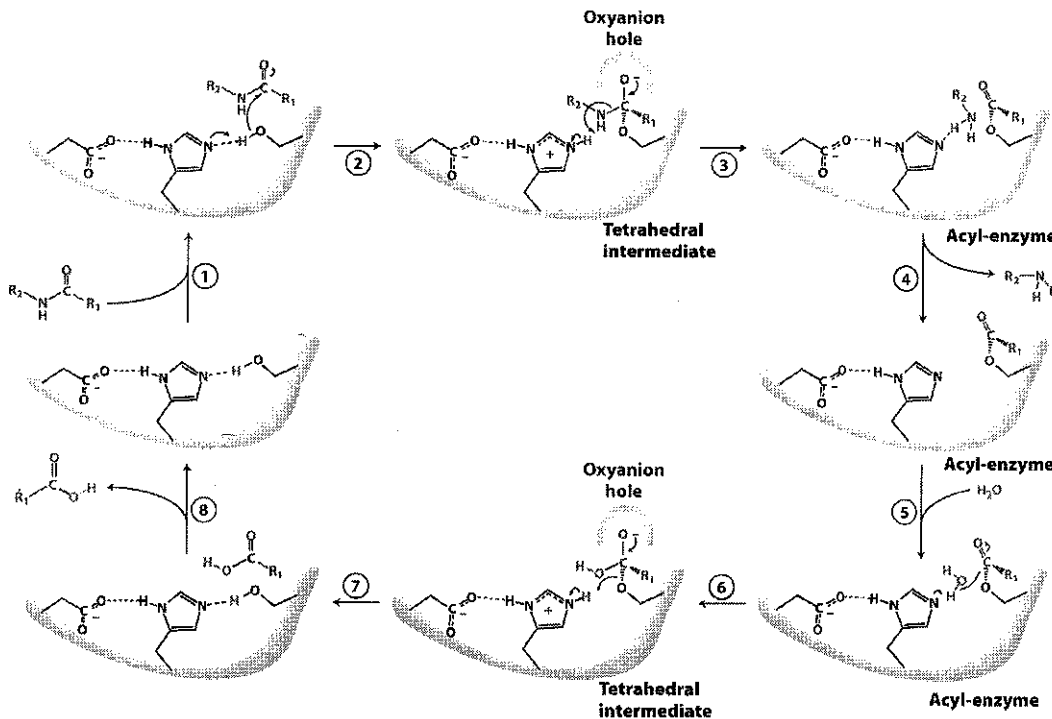


Figure 8.25  
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+2 Which residue of the triad acts as a general acid to stabilize the leaving group? *Histidine*

+2 In how many steps in this cycle depend on transition state stabilization of the tetrahedral intermediate? *two (steps 2 + 6)*

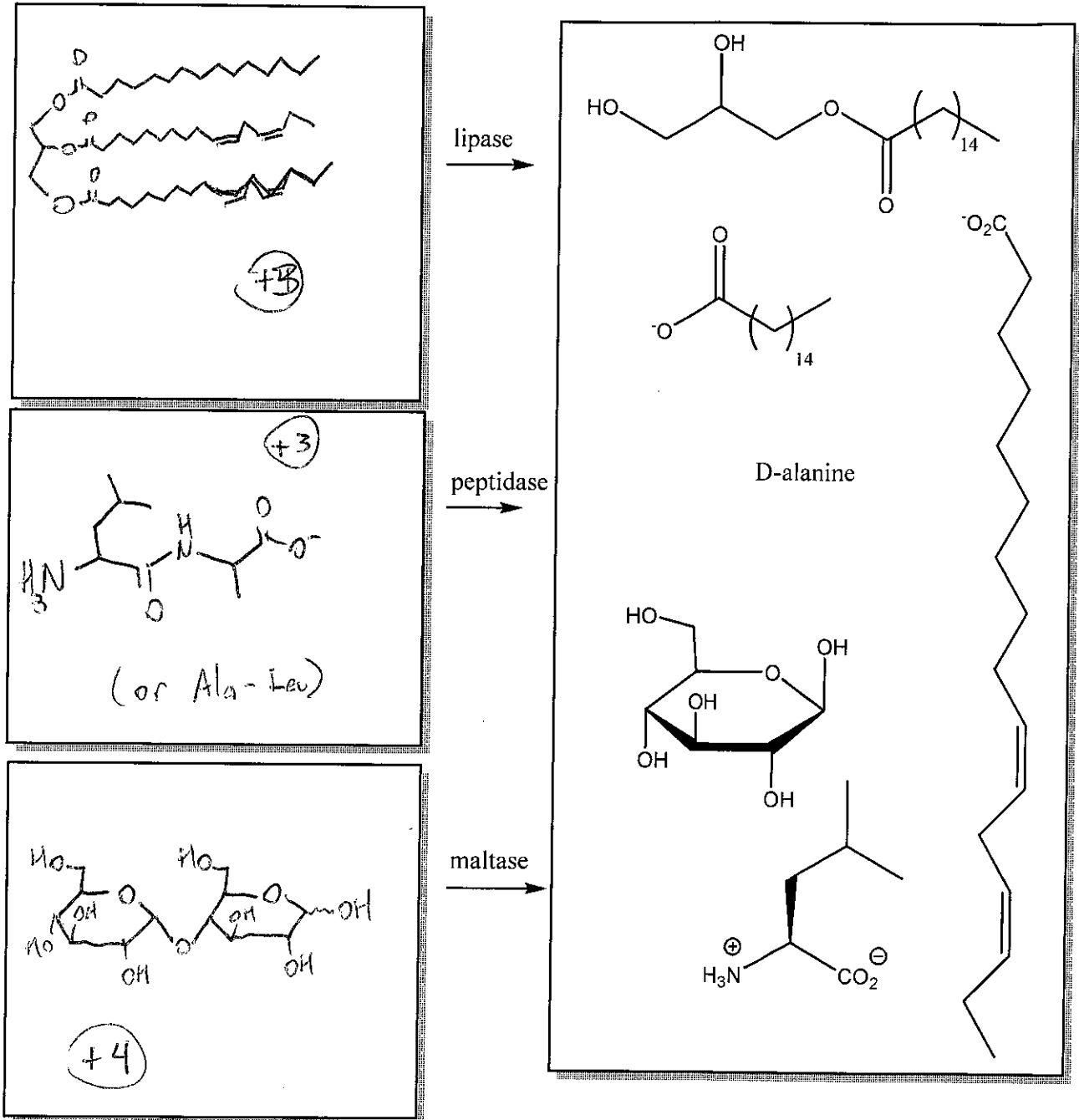
+2 What is the function of the aspartate residue in step 6? *It makes the His a better base to activate water as a Nucleophile*

+2 Give one step that exemplifies nucleophilic catalysis: *step 2*

+2 The starting catalytic triad of step 1 is regenerated in the final reaction of step 8. In the end, it is exactly identical to how it started except that... *the proton on serine is different*



33. A mixture of dietary components entering the intestine encounter a mixture of pancreatic digestive enzymes: lipase, maltase (which hydrolyzes the  $\alpha$  (1 $\rightarrow$ 4) linkage of glucose disaccharides), and a peptidase that is specific for dipeptides. Draw structures for the dietary components that would lead to these compounds entering the intestinal cell.



34. Under normal conditions, glucose is mobilized for ATP generation in muscle in response to epinephrine through the  $\beta$ -adrenergic receptor, but the mobilization stops once epinephrine is no longer present. Explain how these mutations/experiments would change the response.

A. A mutant heterotrimeric G protein is discovered that readily exchanges GDP for GTP even in the absence of activated receptor.

(74) The pathway would be constitutively active because the G-protein would not need to bind to an activated receptor. Therefore, signal will happen even with no ligand.

B. An inhibitor of cAMP phosphodiesterase, which converts cAMP to AMP, is added.

(73) The second messenger will not be destroyed, so the pathway will be active even in the absence of ligand. Glucose will continue being mobilized.

C. A protein in the pathway that is activated by phosphorylation of a serine residue has a S $\rightarrow$ V mutation.

(73) Phosphorylation cannot happen on valine, so the protein will not be activated by the kinase. This will shut off the pathway, and glucose will not be released even in the presence of epinephrine.

**Bonus:** (5pts) Draw a glycolipid in which the  $\alpha$ -anomer of the C-3 epimer of glucose serves as the polar head group of a diacylglyceride with one saturated tail and one polyunsaturated tail.

